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ICHTHYOFAUNA OF THE UPPER SAN DRAINAGE BASIN

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ABSTRACT. Ichthyofauna of the upper San drainage basin was studied in 1993-1999, at 50 sampling sites. Fish were sampled using electric gear, and a questionnaire survey was carried out. Seventeen fish species were observed. Spotted sculpin (*Cottus poecilopus* Heck.), brown trout (*Salmo trutta* m. *fario* L.), and minnow (*Phoxinus phoxinus* (L.)) showed the highest stability index. Spotted sculpin, minnow, brown trout, chub (*Leuciscus cephalus* (L.)), bearded stone loach (*Barbatula barbatula* (L.)), and Balkan barbel (*Barbus meridionalis petenyi* Heck.) predominated in the samples. Fish community composition of upper San drainage basin was similar to that observed in most Carpathian Vistula headwaters. In brown trout population, young individuals predominated. Grayling (*Thymallus thymallus* (L.)) was found at 17 sampling sites, and extended its area to Bieszczady Mountains. Riffle minnow (*Alburnoides bipunctatus* (Bloch)) was one of the rarest species.

Key words: FISH, MOUNTAIN STREAMS, BIESZCZADY MOUNTAINS

INTRODUCTION

Upper San drainage basin includes over 90 kilometers of San River, down to Solina Reservoir, with the main tributaries: Solinka with Wetlina, Wołosaty, and Dwernik. The entire area is protected due to its high natural value (Głowaciński 1993, Michalik 1993). Almost all upper San basin belongs to the International Biosphere Reserve "Eastern Carpathians", Polish part of which consists of Bieszczady National Park and two landscape parks.

Data on fish communities of upper San are scarce and outdated (Solewski 1964, Rembiszewski 1971, Rolik 1971, Skóra 1972). Most extensive information on the ichthyofauna of San drainage basin was provided by Rolik (1971). The author sampled 10 sites in upper part of San drainage area. Studies of fish communities of Bieszczady National Park were initiated in 1993 (Kukuła 1995). The studies continued, including protective outer belt of the park.

The present study was undertaken to evaluate the current state of fish community of upper San drainage basin.

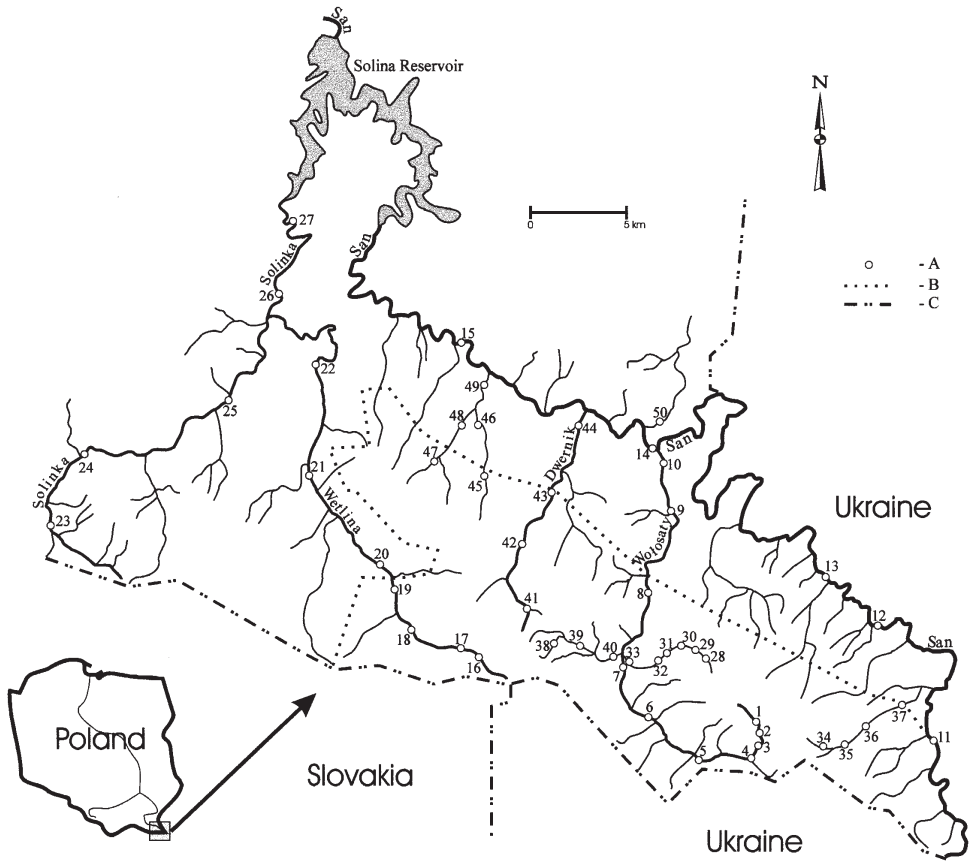

Fig. 1. Location of sampling sites on the upper San drainage basin (A – sampling site; B – border of the Bieszczady National Park; C – state borders).

MATERIAL AND METHODS

The study was carried out in San river and its main tributaries. The fish were harvested at 50 sampling sites (Fig. 1). Detailed morphometric data are shown in Table 1. Along the first 50 km San River resembles a submountain river, but further on, down to Solina Reservoir, it is a typical mountain river, with shallow bed and numerous rapids. Upper San tributaries are typical mountain streams, with quick current and stony bottom.

Samples were collected in 1993-1997. Most sites were sampled at least 3 times a year: in spring, summer and autumn. Only the frontier part of San River and

TABLE 1

Characteristic of sites on the upper San River drainage basin

Name of stream	Site number	Altitude [m]	Gradient [‰]	Width [m]	Mean depth (max) [m]	Type of bottom	Cover (in 4 grade scale)
Wołosatka	1	904	146.7	1-2	0.1 (0.3)	r, bs	+
	2	885	34.5	1-2	0.1 (0.2)	r, bs	+
	3	860	50.0	2-5	0.2 (0.3)	r, bs, s	++
	4	820	39.0	2-5	0.2 (0.5)	r, bs, s	++++
	5	768	26.3	3-5	0.3 (0.6)	r, bs	++++
	6	689	14.3	3-6	0.2 (0.7)	bs, s, r	+++
	7	640	13.8	3-7	0.2 (0.7)	bs, s, r	++++
Wołosaty	8	613	7.6	4-10	0.3 (0.9)	r, bs, s	+++
	9	560	8.5	4-6	0.3 (1.0)	bs, r, s	++
	10	541	6.1	5-10	0.3 (1.0)	r, bs, s	+++
San	11	719	13.8	2-6	0.1 (0.4)	bs, s, g	+
	12	664	4.1	5-8	0.2 (0.7)	bs, s, g	++
	13	650	2.5	6-8	0.3 (0.8)	r, bs, s	++
	14	536	13.1	8-20	0.3 (1.0)	bs, r, s, g	++
	15	485	3.8	20-40	0.3 (1.0)	bs, r, s, g	++++
Górna Solinka	16	801	85.0	2-4	0.2 (0.5)	r, bs	++
	17	775	26.0	2-6	0.2 (0.5)	r, bs, s	+++
	18	714	24.2	3-6	0.2 (0.5)	bs, s, r	++++
	19	650	22.3	4-7	0.3 (0.7)	r, bs, s	+++
Wetlina	20	640	6.7	4-7	0.2 (0.6)	r, bs, s	+++
	21	575	9.7	4-12	0.3 (1.2)	bs, r, s, g	++
	22	540	5.8	6-12	0.3 (0.7)	bs, r, s	++
Solinka	23	670	36.7	2-4	0.1 (0.3)	r, bs,	++
	24	630	12.8	2-4	0.1 (0.6)	r, bs, s	+
	25	515	10.7	4-10	0.2 (0.8)	bs, r, s	++
	26	445	8.5	8-20	0.2 (0.7)	bs, r, s, g	++
	27	420	6.3	8-30	0.2 (0.7)	bs, r, s, g	+
Terebowiec	28	885	177.8	1-2	0.2 (0.4)	r, bs	+
	29	835	71.4	1-2	0.2 (0.4)	bs, s, r	+
	30	790	35.3	2-3	0.2 (0.5)	r, bs	++
	31	740	34.5	3-5	0.2 (0.4)	bs, s, r	+
	32	722	40.0	3-6	0.3 (0.8)	r, bs, s	+++
	33	675	26.5	2-6	0.2 (0.7)	bs, s, g	++++
Halicz	34	845	119.6	1-2	0.1 (0.4)	bs, r, s	+++
	35	820	33.3	2-5	0.1 (0.4)	r, bs, s	++
	36	800	26.7	2-5	0.2 (0.5)	r, s, bs	+++
	37	755	20.0	3-5	0.2 (0.4)	bs, r, s	++

Name of stream	Site number	Altitude [m]	Gradient [‰]	Width [m]	Mean depth (max) [m]	Type of bottom	Cover (in 4 grade scale)
Rzeczyca	38	755	168.0	1-2	0.1 (0.3)	bs, s	+
	39	720	50.0	2-5	0.2 (0.4)	bs, s	++
	40	650	25.5	2-6	0.2 (0.7)	bs, s, g	++
Dwernik	41	785	160.4	1-2	0.1 (0.2)	bs, s	+
	42	693	26.7	3-5	0.3 (0.6)	r, bs	++++
	43	625	27.2	4-8	0.3 (1.0)	r, bs, s	++++
	44	525	15.1	5-10	0.2 (0.8)	r, bs, s, g	++
Hylaty	45	675	155.7	2-4	0.1 (0.6)	r, bs	++
	46	560	35.1	2-4	0.2 (0.7)	r, bs, s	+++
Rzeka	47	645	142.0	1-2	0.1 (0.3)	r, bs	+++
	48	575	26.7	2-4	0.3 (0.5)	r, bs	++
Głęboki	49	510	25.3	2-5	0.2 (0.4)	r, bs, s	++
Smolnik	50	535	19.5	2-4	0.2 (0.5)	bs, s, g, sa	+++

(r – rocks; bs – big stones; s – stones; g – gravel; sa – sand)

Smolnik Stream were sampled once, in summer 1997. For the sites sampled more than 3 times a year, the results of one sampling in each season are shown (Fig. 2 a-e). The fish were harvested using electric fishing gear IUP-12, moving upstream. At wider sampling sites, two gears were used simultaneously. Each site was sampled according to Beklemishev's rule (Backiel, Penczak 1989). The fish were identified, counted, and weighed, scale samples were taken from some of them. After measurements, the fish were released. The communities were described using two biocenotic parameters: quantitative dominance $D = 100\ n_i / N$, and stability index $C = 100\ N_a / N_n$ (where n_i – number of individuals of species "i" in the sample, N – number of all individuals, N_a – number of sites in which the species was found, N_n – total number of sites).

In summer 1997-1999, questionnaire surveys were also performed. Information was obtained from 33 anglers. These data, and own observations of 1993-1999, were used to supplement the electrofishing results.

RESULTS

The analysed material consisted of 6088 fish of 16 species, of total weight 217565 g. The highest stability index was observed for spotted sculpin (*Cottus poecilopus* Heck.), brown trout (*Salmo trutta* m. *fario* L.), and minnow (*Phoxinus phoxinus* (L.)).

With respect to the number of individuals, spotted sculpin, minnow, brown trout, chub (*Leuciscus cephalus* (L.)), bearded stone loach (*Barbatula barbatula* (L.)), and Balkan barbel (*Barbus meridionalis petenyi* Heck.) predominated (Table 2).

TABLE 2

Indices of occurrence stability (C) and dominance (D) in the upper San drainage basin

Species	C	D
Cottus poecilopus Heck.	100	34.13
Salmo trutta m. fario L.	94	13.40
Phoxinus phoxinus (L.)	54	19.71
Barbatula barbatula (L.)	36	6.77
Barbus meridionalis petenyi Heck.	24	5.96
Leuciscus cephalus (L.)	28	8.41
Thymallus thymallus (L.)	28	1.72
Perca fluviatilis L.	22	3.71
Leuciscus leuciscus (L.)	20	1.30
Alburnoides bipunctatus (Bloch)	10	0.38
Chondrostoma nasus (L.)	6	0.25
Alburnus alburnus (L.)	16	2.51
Cottus gobio L.	14	0.90
Rutilus rutilus (L.)	10	0.33
Gobio gobio (L.)	6	0.46
Oncorhynchus mykiss Richardson	4	0.05

WOŁOSATKA STREAM (WOŁOSATY)

At the highest site (1) only one species was found – spotted sculpin. At other four sites, along with the predominating spotted sculpin (over 78% of total number of fish), also brown trout occurred, mainly individuals under 220 mm. At site 6, the share of spotted sculpin dropped to 69.7%, and minnow appeared. At sites 7-10, number of species increased to 11 (Fig. 1a). Own observations and questionnaire data showed that in middle and lower Wołosaty, also undermouth (*Chondrostoma nasus* (L.)) and roach (*Rutilus rutilus* (L.)) were present. In 1999, at sites 7 and 8, the share of grayling (*Thymallus thymallus* (L.)) increased compared to previous years. Most of harvested graylings and trouts were large (maximum total length of trout was 355 mm, and of grayling – 305 mm).

SAN RIVER

In upper San, spotted sculpin predominated (76%) (Fig. 1b). At sites 12 and 13, minnow was most numerous (36.6% and 29.3% respectively), with high share of bleak

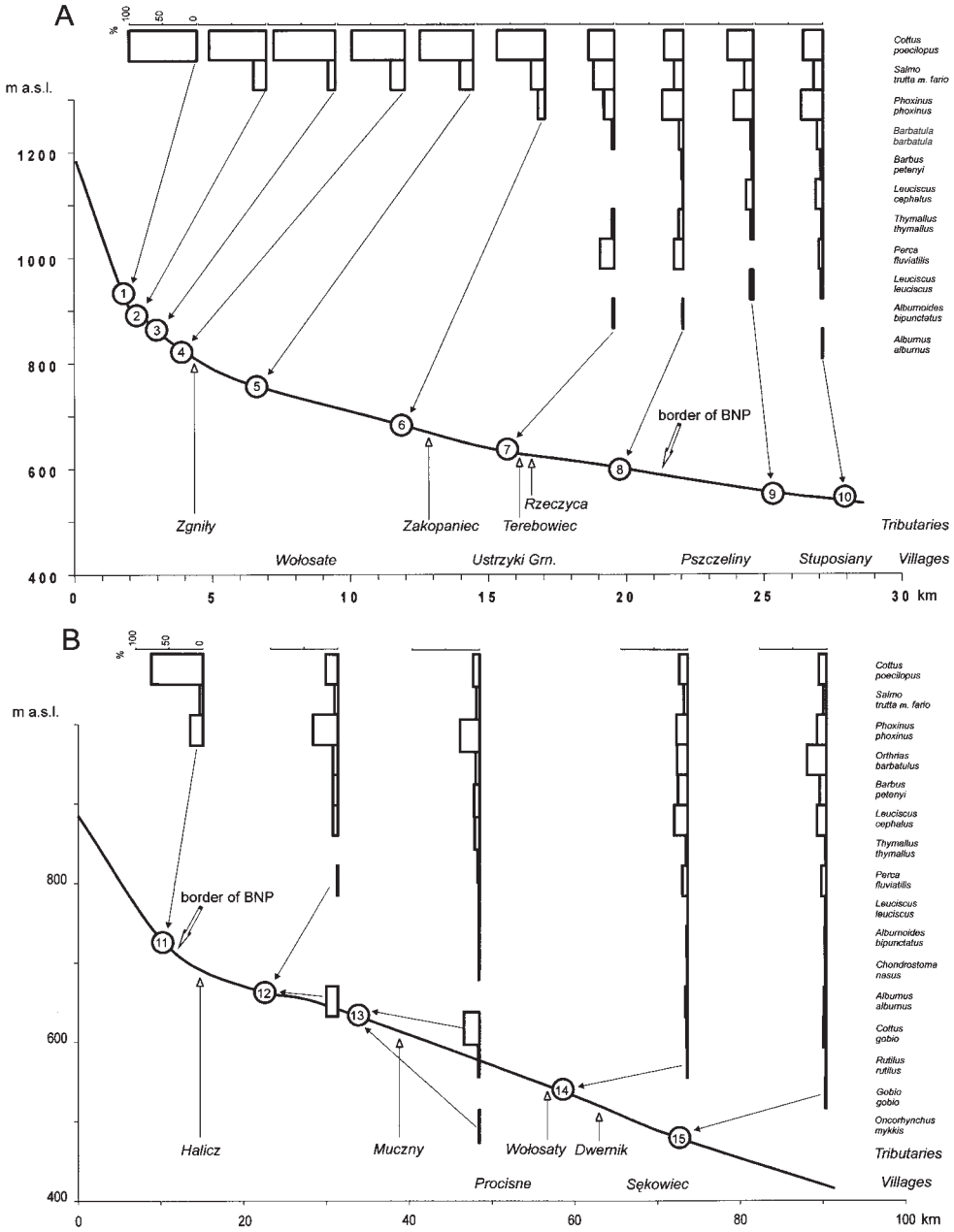

Fig. 2. Percentage share of fish species in total abundance of ichthyofauna: A – the Wołosatka – Wołosaty Stream; B – the San River

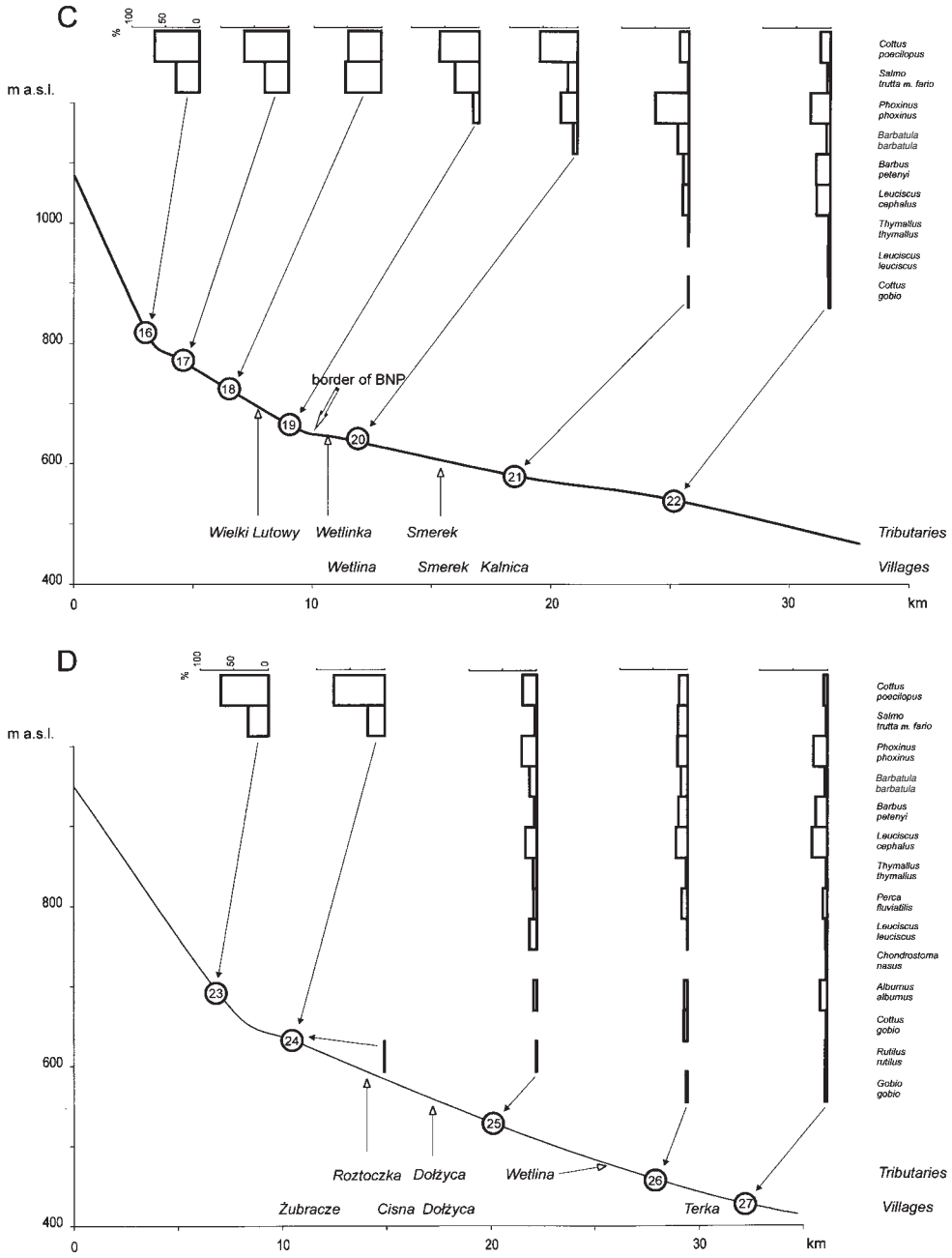

Fig. 2. Percentage share of fish species in total abundance of ichthyofauna: C – the Górna Solinka – Wetlina River; D – the Solinka River

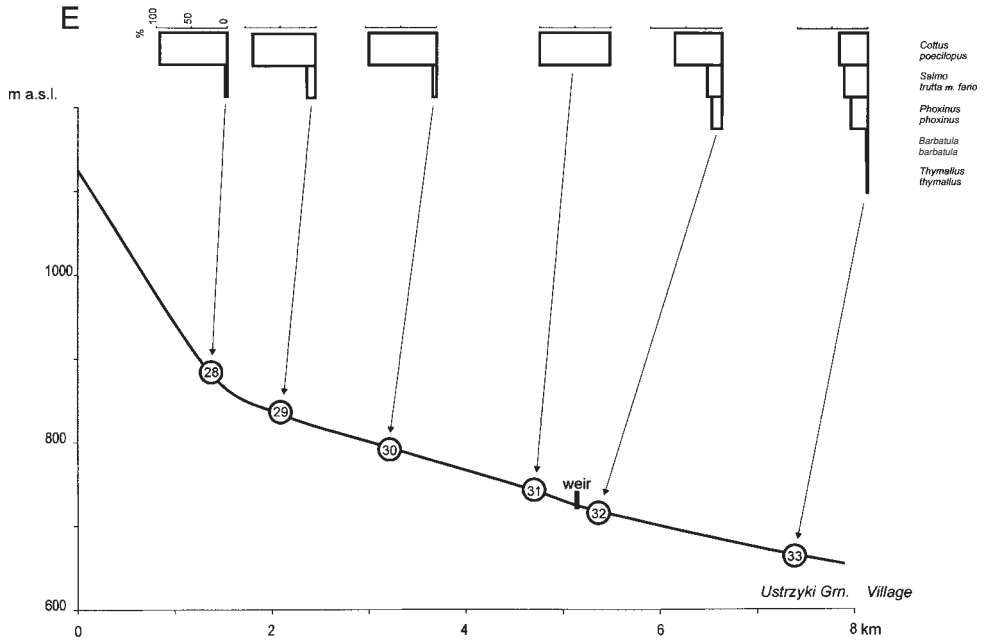

Fig. 2. Percentage share of fish species in total abundance of ichthyofauna: E – the Terebowiec Stream.

(*Alburnus alburnus* (L.)). At site 12, fish of 8 species were caught, and at site13 – 13 species. The largest brown trout was 300 mm long. At sites 14 and 15, situated lower, 15 species were found, among which bearded stone loach, minnow, chub, and Balkan barbel predominated, spotted sculpin still being fairly numerous (over 10% of fish). Questionnaire data and own observations indicated that rainbow trout (*Oncorhynchus mykiss* Richardson) and lake trout (*Salmo trutta* m. *lacustris* L.) were also present. In lower San, below "Krywe" reserve, where no electrofishing was done, along with the species mentioned above also barb (*Barbus barbus* (L.)) was sometimes caught by anglers, and in the river mouth - bream (*Abramis brama* (L.)), crucian carp (*Carassius carassius* (L.)), white bream (*Blicca bjoerkna* (L.)), pike-perch (*Stizostedion lucioperca* (L.)), and pike (*Esox lucius* (L.)).

UPPER SOLINKA (WETLINA)

In the upper part (sites 16-20), spotted sculpin predominated (over 65%), only at site 18 brown trout was slightly more numerous (Fig. 1c). At site 19, minnow comprised about 9% of fish. In the lower part of the river (sites 21 and 22), 9 fish species

were noted, predominated by minnow. Among brown trouts and graylings mainly small individuals were caught. Additionally, at site 19, bearded stone loach was observed (the results of this electrofishing are not shown). In the upper Solinka (sites 19 and 20), grayling was also sometimes caught.

SOLINKA RIVER

Upper river stretch was inhabited mainly by spotted sculpin (Fig. 1d). Brown trout did not exceed 220 mm. In spring, roach was caught at site 24. In the middle and lower Solinka (sites 25-27), 14 species of fish were found. Additionally, rainbow trout sometimes appeared in angler's catches. Minnow (13.6%-20.9%) and chub (15.9%-22.1%) predominated. At site 25, spotted sculpin comprised 19.4%, and at 27 – barb reached 17%. Most brown trouts and graylings caught in Solinka did not exceed 250 mm. In lower and middle river stretches, chubs over 300 mm were quite numerous, and the individuals over 1000 g were caught.

TEREBOWIEC STREAM

In upper part of the stream (sites 28-30), spotted sculpin comprised 88.5-96.7% of all harvested fish (Fig. 1e). Brown trout did not exceed 190 mm. At site 31, over rapids, only 1 species was found. Below the rapids (site 32), spotted sculpin comprised over 65% of all caught fish. In the stream mouth, some bearded stone loach and grayling fry occurred.

HALICZ STREAM

Only 3 fish species were found there (Table 3). At 3 upper sites (34-36), spotted sculpin predominated, with high share of brown trout (up to 50%). On the contrary, at site 37, trout were less numerous.

RZECZYCA STREAM

In upper part of the stream (site 38), only spotted sculpin was found. In the middle flow (39), minnow was equally numerous, and scarce brown trout were observed. Lower part of the stream was inhabited by 6 species, with minnow predominating. Brown trout comprised over 18% of caught fish, and grayling was also fairly numerous (Table 3). Unpublished own data indicate that grayling recently appeared also in upper part of the stream (site 39).

DWERNIK STREAM

In the Nasiczne waterfall region (sites 41-43), two species were observed, in the lower part – also another 4 species (Table 3).

TABLE 3

Percentage share of fish species in total abundance of ichthyofauna

Species	Site																
	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Cottus poecilopus	57.1	50.0	56.1	89.6	100	45.6	16.7	88.9	47.4	65.9	61.5	73.6	43.2	86.4	91.3	53.2	28.0
Salmo trutta m. fario	42.9	50.0	36.4	3.9		8.9	18.3	11.1	52.6	34.1	11.2	26.4	50.7	13.6	8.7	27.5	28.0
Phoxinus phoxinus			7.6	6.5		45.6	58.7				19.6		6.2			19.3	30.0
Barbatula barbatula							0.8				0.7						6.0
Leuciscus cephalus											4.9						4.0
Thymallus thymallus							4.8										
Perca fluviatilis							0.8										
Leuciscus leuciscus											2.1						
Oncorhynchus mykiss																	4.0
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

HYLATY, RZEKA AND GŁĘBOKI STREAMS

At site 45, only spotted sculpins and brown trout were caught. Below the waterfalls (site 46), also minnow was observed, and among the trouts – individuals over 200 mm were quite numerous, the largest one being 430 mm long. At sites 47 and 48, spotted sculpin predominated (over 86%). In Głęboki Stream, 3 fish species occurred, spotted sculpin being a dominant, accompanied by fairly numerous brown trout and minnow.

SMOLNIK STREAM

Among 6 fish species, equal share of spotted sculpin, brown trout and minnow (Table 3) was observed. Rainbow trout was also noted.

DISCUSSION

Earlier data on the ichthyofauna of upper San drainage basin were collected in the '50 and '60. At that time, 15 species of fish were found, and 1 species of lamprey (Solewski 1964, Rembiszewski 1971, Rolik 1971). Now 17 species, including lake trout, occur and the lampreys were not observed.

In the nineties, species composition of fish communities of upper San tributaries was similar to that observed in upper parts of most Carpathian Vistula tributaries (Skóra, Włodek 1988, 1991, Starmach et al. 1988, Augustyn et al. 1996, 1998). Similarly as in most Carpathian Vistula tributaries, brown trout was represented mainly by young fish. Higher densities of 3+ old individuals were observed at several sites only within the Bieszczady National Park. Poaching is one of the most serious causes of unsatisfactory trout density (Kukuła 1996), reducing number of trout also in other rivers (Skóra, Włodek 1989, 1991, Skóra et al. 1994, Augustyn et al. 1998).

Grayling, which was not observed earlier in San basin (Rolik 1971, Witkowski et al. 1984), comprised 1.72% of all harvested fish. It was observed at 14 sites, and appeared at further 3 in 1998-1999. Large individuals were scarce. However, unpublished data of the last 2 years indicate that grayling population in Wołosaty Stream increases. Contrary to most Carpathian rivers and streams, where grayling becomes endangered (Skóra, Włodek 1988, 1991, Starmach et al. 1988, Augustyn et al. 1998), this species extended its area in Bieszczady.

Riffle minnow (*Alburnoides bipunctatus* (Bloch)) was one of the rarest species observed in the present study. The species, once very numerous in upper San drainage basin (Skóra 1972), is now endangered in all Poland (Witkowski et al. 1999), also in Bieszczady.

Relatively high number of perch and appearance of roach must be related to the construction of Solina Reservoir, where both species are very numerous (Bieniarz, Epler 1993).

Electrofishing did not reveal any lake trout, but presence of this species in Solina Reservoir (Wajdowicz 1979), and information on angler catches indicate that lake trout became a component of upper San drainage basin ichthyofauna.

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STRESZCZENIE

ICHTIOFAUNA DORZECZA GÓRNEGO SANU

W 1993-1999 prowadzono badania ichtiofauny dorzecza górnego Sanu. Wyznaczono 50 stanowisk połowu ryb (Ryc. 1, Tab. 1). Odłowy ryb przeprowadzono za pomocą impulsowego urządzenia połowowego IUP-12 w latach 1993-1997. Na większości stanowisk łowiono co najmniej trzykrotnie: wiosną, latem i jesienią. Charakteryzując zespoły ryb posłużono się dwoma współczynnikami biocenotycznymi: dominacją ilościową i stałością występowania. Informacje o rozmieszczeniu gatunków uzupełniono badaniami ankietowymi przeprowadzonymi wśród wędkarzy.

Analizowany materiał stanowiło 6088 ryb o łącznej masie 217 565 g. Stwierdzono 16 gatunków ryb, a 17 jest troć jeziorowa sporadycznie łowiona przez wędkarzy. Najwyższy współczynnik stałości (C) miały: głowacz pręgopłetwy (*Cottus poecilopus* Heck.), pstrąg potokowy (*Salmo trutta* m. *fario* L.) i strzebla

potokowa (*Phoxinus phoxinus* L.). W analizowanym materiale dominujące pod względem ilości złowionych osobników były głowacz pręgopłetwy, strzebla potokowa, pstrąg potokowy, kleń (*Leuciscus cephalus* L.), śliz (*Barbatula barbatula* L.) oraz brzanka (*Barbus meridionalis petenyi* Heck.) (Tab. 2).

Ichtiofauna dorzecza górnego Sanu ma skład gatunkowy zbliżony do górnych odcinków większości karpackich dopływów Wisły (Ryc. 1a-e, Tab. 3). Pstrąg potokowy reprezentowany był głównie przez najmłodsze roczniki. Większe zagęszczenie osobników w wieku 3+ i starszych stwierdzano na niektórych stanowiskach w obrębie Bieszczadzkiego Parku Narodowego. Jedną z przyczyn niezadowalającej liczebności pstrąga potokowego jest kłusownictwo.

Lipień nie notowany wcześniej w dorzeczu Sanu stanowił 1.72% wszystkich złowionych ryb. Stwierdzono go na 14 stanowiskach, a na trzech dalszych pojawił się w latach 1998-1999. Jednym z najrzadziej spotykanych gatunków ryb była piekielnica (*Alburnoides bipunctatus* Bloch.), gatunek zagrożony również w Bieszczadach. Stosunkowo dużą liczebność okonia oraz pojawienie się płoci należy wiązać z powstaniem Zbiornika Solińskiego, gdzie oba te gatunki należą do najliczniejszych.

ADRES AUTORA

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